REMARKS

Claims 1-3, 6-14, 16-21, and 24-26 are pending. Claims 5 and 23 are canceled with this reply. Claims 1 and 13 are amended with this reply. Support for the amendments can be found, for example, at pages 10-11 of the specification, and in the claims as originally filed. No new matter has been added.

Obviousness-type double patenting rejection

The Examiner rejected claims 1-3, 5-14, 16-21 and 23 on the ground of obviousness-type double patenting over claims 1-24 of U.S. Patent No. 7,181,266 (see pages 2-3 of the Office Action).

A terminal disclaimer under 37 C.F.R. § 1.321(c) is being filed with this reply to obviate the double patenting rejection over U.S. Patent No. 7,181,266. In view of the terminal disclaimer being filed with this reply, Applicants respectfully request that the rejections under the judicially created doctrine of obviousness-type double patenting be reconsidered and withdrawn.

Rejections under 35 U.S.C. § 102(b)

Barbera-Guillem

The Examiner rejected claims 1-2, 6-8, 13, 14 and 16-21 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,333,110 to Barbera-Guillem et al. ("Barbera-Guillem") (see page 3 of the Office Action). The Examiner states that Barbera-Guillem discloses an emission wavelength range above 700 nm and that wavelengths above 700 nm are in the infrared wavelength range (see Office Action at 3-4). Applicants respectfully disagree. Claims 1 and 13 are independent, and have each been amended with this reply.

The amendment to claim 1 serves to incorporate the substance of claim 5 (now canceled). Claim 5 was not rejected over Barbera-Guillem, because the reference does not teach a nanocrystal that includes a core of a first semiconductor material and an overcoating of a second semiconductor material on the core, where the first semiconductor material and the second

semiconductor material are selected so that, upon excitation, one carrier is substantially confined to the core and the other carrier is substantially confined to the overcoating.

In a similar fashion, the amendment to claim 13 serves to incorporate the substance of claim 23 (now canceled). Claim 23 was not rejected over Barbera-Guillem, because the reference does not teach a nanocrystal that includes a core of a first semiconductor material and an overcoating of a second semiconductor material on the core, where the first semiconductor material and the second semiconductor material are selected so that, upon excitation, one carrier is substantially confined to the core and the other carrier is substantially confined to the overcoating.

Applicants respectfully ask that the rejection under § 102 of independent claims 1 and 13, and the claims that depend from them, be reconsidered in view of the amendment and withdrawn.

Rejections under 35 U.S.C. § 103(a)

Barbera-Guillem and Barbera-Guillem in view of Bawendi

The Examiner rejected claims 24-26 under 35 U.S.C. § 103(a) as being obvious over Barbera-Guillem, and claim 3 as obvious over Barbera-Guillem in view of U.S. Patent Publication No. 2001/0040232 to Bawendi et al. ("the '232 publication") (see page 4-5 of the Office Action). Claims 3 and 24 depend from independent claim 1. Claims 25 and 26 depend from claim 13. Applicants respectfully disagree.

As discussed above, the amendments to claims 1 and 13 serve to incorporate the substance of claims 5 and 23, respectively. Claims 5 and 23 are now canceled. Neither Barbera-Guillem nor the '232 publication teach, suggest, or in any way motivate a person of ordinary skill in the art to make a nanocrystal that includes a core of a first semiconductor material and an overcoating of a second semiconductor material on the core, where the first semiconductor material and the second semiconductor material are selected so that, upon excitation, one carrier is substantially confined to the core and the other carrier is substantially confined to the overcoating.

Applicants respectfully ask that the rejection under § 103 of claims 3 and 24-26 be reconsidered in view of the amendment and withdrawn.

Barbera-Guillem in view of Bryant

Claims 5, 9-12, and 23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Barbera-Guillem in view of Bryant et al., "Designing quantum dots and quantum-dot solids," *Physica E* **2001**, 11, 72-77 ("Bryant") (see pages 5-6 of the Office Action). As discussed above, the amendments presented in this paper cancel claims 5 and 23. Although such cancellation technically renders the rejection of those claims moot, Applicants recognize that the reasoning used in the rejection of claims 5 and 23 is applicable to claims 1 and 13 as currently amended. The rejections are therefore addressed here.

Independent claims 1 and 13 each relate to a composition or a method including a nanocrystal that includes a core of a first semiconductor material and an overcoating of a second semiconductor material on the core wherein the first semiconductor material and the second semiconductor material are selected so that, upon excitation, one carrier is substantially confined to the core and the other carrier is substantially confined to the overcoating. As discussed above, Barbera-Guillem does not disclose a nanocrystal having materials selected so that, upon excitation, one carrier is substantially confined to the core and the other carrier is substantially confined to the overcoating.

Bryant describes theoretical calculations regarding quantum-dot quantum-well "mulitshell nanocrystallites" in which "the shell can act as an electron and hole trap" (see page 5 of the office action of April 4, 2007). For example, in a CdS/HgS/CdS quantum-dot quantum-well, "HgS acts a quantum well for both electrons and holes." (Bryant at 74, bridging col. 1-2) Bryant does not teach or suggest that one carrier is substantially confined to the core and the other carrier is substantially confined to the overcoating; in Bryant, both carriers, the electron and the hole, are confined in the same semiconductor material.

To further illustrate this point, the Examiner is referred to U.S. Patent No. 7,390,568 to Kim et al. ("Kim"), and to "Quantum-dot quantum well CdS/HgS/CdS: Theory and Experiment" Schooss, D., et al., *Phys. Rev. B* **1994**, 49, ("Schooss"), attached as Appendix A. Schooss is cited by Bryant as reference 3 (Bryant at 77, col. 2). The Kim patent issued from Application No. 10/638,546, which was incorporated by reference in its entirety (see specification at 10-11).

The materials described in Bryant and Schooss involve two different semiconductor

materials (e.g., CdS and HgS) arranged in particular structure (e.g., CdS/HgS/CdS, or more generically, barrier/well/barrier). The valence and conduction bands of the semiconductor materials thus have a particular radial profile, as illustrated in Schooss Fig. 1, reproduced below (Schooss at 17074). The well material has a valence band lying at a higher energy than does the barrier material (lower trace), and a conduction band energy level that lies at a lower energy than does the barrier material (upper trace). This energy structure results in **both** of the charge carriers of an exciton, i.e., **both** the electron and the hole, being localized in the well material. See Schooss at, e.g., Fig. 5, page 17076.

Kim describes how materials that involve two different semiconductor materials (e.g., CdTe and CdSe) can be arranged in particular structure (e.g., CdTe/CdSe, or more generically, core/shell). The valence and conduction bands of the semiconductor materials thus have a particular radial profile, as illustrated in Kim Fig. 2, a detail of which is reproduced below. In this case, the shell material has a valence band lying at a **lower** energy than does the core material (lower trace), and a conduction band energy level that lies at a lower energy than does the core material (upper trace). This energy structure results in the charge carriers of an exciton, i.e., the electron and the hole, being confined **separately** to the shell and core, respectively. See Kim at, e.g., Fig. 2, and at col. 4, line 64-col. 5, line 26.

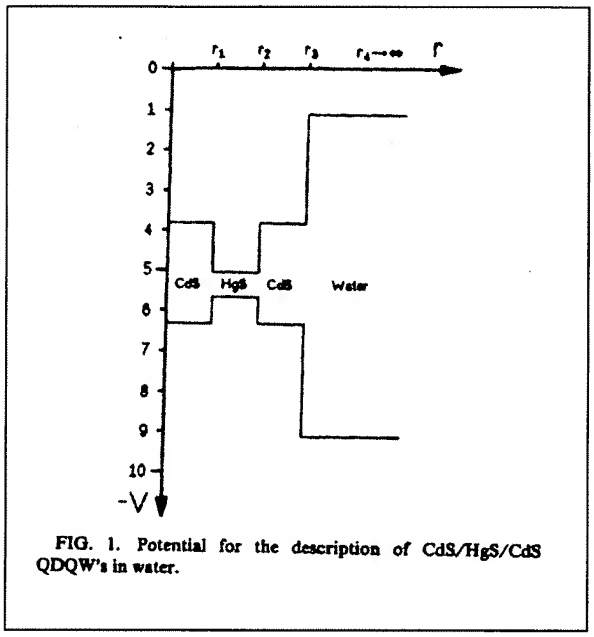
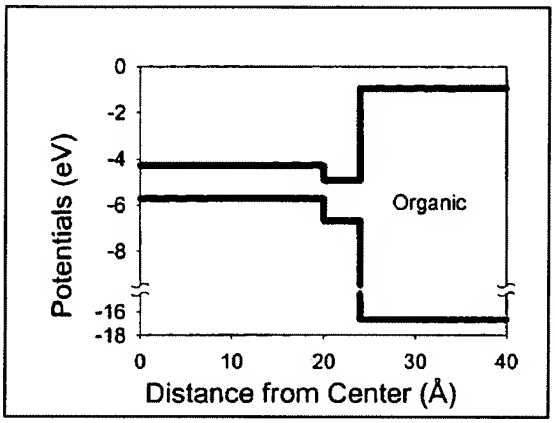


FIG. 1. Potential for the description of CdS/HgS/CdS QDQW's in water.

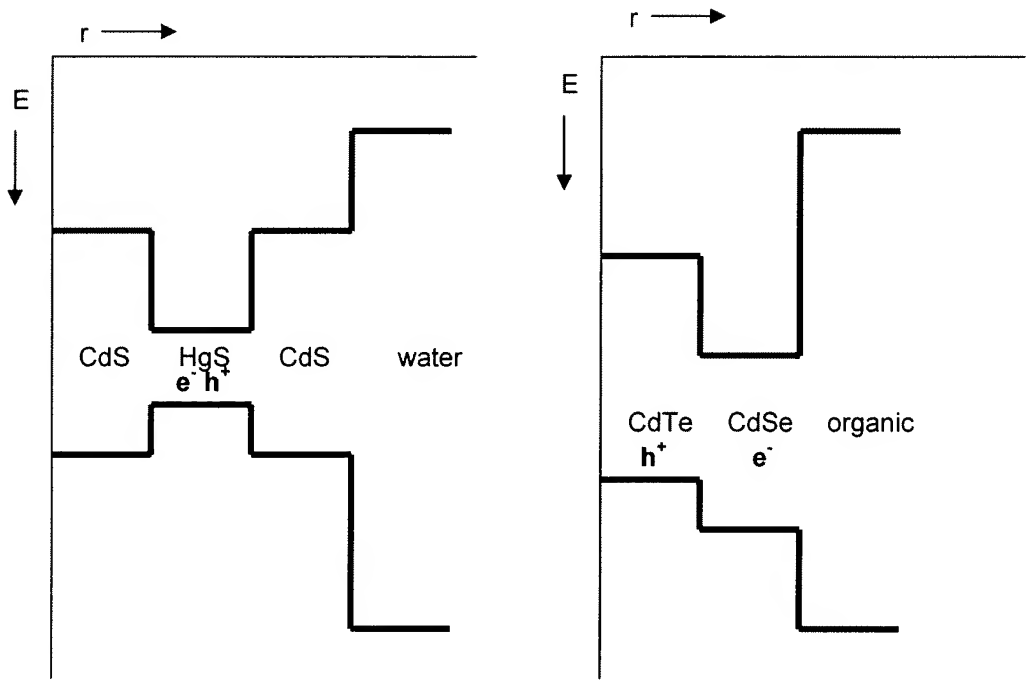
Figure 1 of Schooss



Detail from Figure 2 of Kim

Schematic[1] versions of these figures are shown below, with the legends $\mathbf{e}^-$ and $\mathbf{h}^+$ providing a visual depiction of the localization of charge carriers upon excitation.

[1] The schematic versions are not intended to convey any quantitative values of either radius or energy, nor to compare energy levels of semiconductor materials between the left and right panels.



Schematic comparison. Left panel: a diagram of the energy levels of a barrier/well/barrier QDQW as described in Bryant and Schooss, with both electron (e^-) and hole (h^+) confined to well material. Right panel: a diagram of the energy levels of a core/shell nanocrystal where one carrier (the hole, h^+) is substantially confined to the core, and the other carrier (the electron, e^-) is substantially confined to the overcoating, as described, e.g., in Kim.

The Examiner argues that Bryant teaches a "multilayer nanocrystal heteronanostructures" (Office Action at 5) in which "the shell can act as an electron and hole trap" (see page 5 of the office action of April 4, 2007). The Examiner also contends that it would have been obvious to modify Barbera-Guillem to provide a multilayer nanocrystal. "Such a modification involves the substitution of one known type of nanocrystal arrangement for another. The selection of the materials would have been obvious based upon known suitability for intended use." Office Action at 6. Applicants respectfully disagree.

A person of ordinary skill in the art would not arrive at a composition according to claim 1 or a method of claim 13 from combining Barbera-Guillem with Bryant. Neither reference indicates that it may be desirable to select semiconductor materials so that upon excitation, one carrier is substantially confined to the core and the other carrier is substantially confined to the

overcoating. A nanocrystal with the claimed configuration can have an effective band gap "to the red of either of the two semiconductors making up the structure." These nanocrystals "can have emission wavelengths previously unavailable with the semiconductor of the nanocrystal core." Specification at 11. The references do not describe how the configuration described in claim 1 can operate with different physical effects (e.g., charge carrier separation) and have different properties (e.g., an effective band gap to the red). A person of ordinary skill would not be motivated by Barbera-Guillem and Bryant to select semiconductor materials according to the claims.

Neither Barbera-Guillem nor Bryant teaches, suggests, or motivates a person of ordinary skill in the art to make a nanocrystal where, upon excitation, one carrier is substantially confined to the core and the other carrier is substantially confined to the overcoating. Thus, neither Barbera-Guillem, Bryant, nor their combination teaches or suggests all the limitations of claim 1 or 13, or the claims that depend from them.

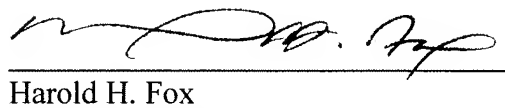
Applicants respectfully request reconsideration and withdrawal of this ground of rejection.

CONCLUSION

In light of the foregoing amendments and remarks, Applicants respectfully ask that all claims be allowed. A petition for a three-month extension of time is filed with this reply. Please apply any charges or credits to deposit account 19-4293.

Respectfully submitted,

Date: 4-1-09



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